PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in and relating to Methods of Coating Metals.

We, THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, a British Company having its registered office at Crown House, Aldwych, London, W.C.2, (Assignees of GOODWIN HORACE HOWE, of 2, Alexander Avenue, Scotia, County of Schenectady, State of New York, United States of America, a citizen of the United States of America) do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates broadly to the protection of surfaces of metals which are subject to corrosion or oxidation. More specifically, this invention is concerned with an improved process for coating such metals with a protective layer of chromium.

It has been proposed heretofore to coat the surfaces of metals, either ferrous or non-ferrous, which are subject to corrosion or oxidation, with protective metals such as chromium by bringing the coating m tal with or without an inert medium, such as aluminium oxide, directly into contact with the surface to be coated and then heating for a requisite period of time at the proper temperature. While this method is successful in effecting a coating of protective metal on the surface of the metal coated, its practice is, nevertheless, limited in certain cases. For example, where objects of varied or complex shape have been involved, a large amount of material has been required to be packed around the object in order to insure complete coating of all the surfaces thereof. Again, the objects must always be packed with more or less care so that the surfaces may receive the proper coating of protective metal. Moreover, it is often inconvenient to handle large amounts of this packing material in coating objects by this method.

It has been recognised that coating with a protective metal in the vapour phase not only facilitates the operation and makes possible and practical the coating of objects with a minimum amount of coating material, but also produces a better coating of protective metal. The coating in the vapour phase of metals with zinc and aluminium has been accomplished heretofore with comparatively little difficulty inasmuch as relatively low temperatures could be used in effecting the operation. For example, while zinc melts at about 419° C. and boils at about 930° C. its vapour pressure is such that at about 400° C. coating in the vapour phase may be successfully carried out. However, with chromium as the coating metal no such low temperature can be used in carrying out the coating operation in the vapour phase. Chromium melts in the vicinity of 1615° C. and in order to effect a coating with this metal in the vapour phase it requires a temperature in the neighbourhood of 1500° to 1600° C., and heating at this temperature for a prolonged period of time. Obviously, such high temperatures are not practical for commercial application.

In this connection it has already been proposed to coat articles with chromium by a vapour phase process by heating the article to incandescence in the presence of, but out of contact with, metallic chromium, and in the presence of iodine which combines with the chromium and is then liberated, the chromium being deposited on the article.

According to the invention the metal to be protected is heated in the presence of, but out of contact with, chromium, the article and the chromium being contained in a porous receptacle which is packed in an inert material containing a small amount of a carrier, by which we mean a substance which acts as a carrier by dissociating on heating with the formation of an acid capable of uniting with the chromium and subsequently being liberated therefrom.

The article to be protected is placed in a receptacle such as a porous alundum tube which is then closed at its open ends and within which has also been placed, but out of contact with the article, a relatively small amount of chromium. This receptacle is preferably placed in another suitable container,

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such as an iron tube, and is packed with an inert material such as aluminium oxide and containing a small amount of the carrier. If desired, some chromium may be added to the inert material but this is not necessary. The container so packed is then placed in a furnace and heated for the requisite period of time, the atmosphere of the furnace being either air or an inert or reducing atmosphere, if desired, although the latter is not necessary to the successful operation of the process. The chromium deposits on the article in the form of a smooth, adherent, resistant protective coating and is very similar to a coating of chromium obtained by electro-deposition.

As illustrative of the process of the invention, but in no way limiting it, the following is given:

A piece of iron in the form of a wire or rod, the exact shape being of no material consequence, is placed in a porous alundum container together with a small amount of chromium, preferably a few small pieces of chromium. The chromium is at one side of and out of contact with the iron. The alundum container which may be in the form of a piece of tubing, is then plugged at its open ends with asbestos paper. It is then placed in an iron container such as an iron tube and completely surrounded by an inert medium. This inert medium may consist of such material as aluminium oxide to which may be added, if desired, some chromium. Mixed with this inert material is a small percentage of a carrier. As an example of the carrier which we employ ammonium chloride is cited. A convenient mixture to use for the inert medium comprises approximately 49% aluminium oxide, 50% powdered chromium, and 1% ammonium chloride. The iron tube packed with this mixture is placed in a cold air furnace and heated to about 1000° C. for about two hours. After this treatment the iron rod has a bright, resistant coating of chromium thereon.

The mixture outside of the alundum tube may consist entirely of an inert material, such as aluminium oxide, with the carrier and the same results will be obtained as above. The percentage of carrier which may be used may be varied although we have found that up to approximately 2% by weight of carrier yields the best results. Results with about 5% by weight of the carrier are not satisfactory. The temperature at which the coating takes place may be varied within the approximate limits 950° to 1100° C., although we have found that about 1000° C. is the optimum temperature. The time of heating is considerably shorter than that necessary where the coating is packed around the object to be coated and in general depends on the size of the object to be protected. Two hours ordinarily gives a good protective layer, and there is usually no object in prolonging the heating much beyond this period as the carrier is usually spent by this time.

While we do not wish to be limited to the following theory, the best explanation we now have as to the mechanism of the process is as follows:

Assuming that ammonium chloride is used as the carrier for the chromium during heating the ammonium chloride breaks down into ammonia and hydrochloric acid, the latter combining with the metallic chromium to yield chromium chloride which in turn reacts with the foundation metal, iron, for example, the chromium depositing thereon in the form of a smooth adherent, resistant, hard coating. The reactions take place in the vapour phase, the ammonium chloride acting as the carrier for the chromium.

It is evident that the present process gives a convenient and practical way of protecting metallic surfaces against corrosion or oxidation, using chromium as the protective metal. The temperature at which the process may be carried out is considerably lower than when no carrier is used for the chromium, and the time of heating is materially shortened. A much smoother coating of protective metal is obtained by means of the present invention than is obtained by the use of prior processes involving the packing of the coating metal directly on the object coated.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The method of providing a foundation metal with a protective coating of chromium by a vapour phase process, which comprises heating the said metal in the presence of, but out of contact with, chromium, said foundation metal and chromium being contained in a porous receptacle which is packed in an inert medium containing a small amount of a carrier substance of the type described.

2. The method according to Claim 1, in which the carrier is ammonium chloride.

3. The method according to Claim 1, in which the carrier is about 2% by weight of the inert medium.

4. The method according to any previous claim, in which the heating is

effected at about 1000° C. until the coating results.

5. The method of providing a foundation metal with a protective coating of chromium, which comprises placing the foundation metal in a closed porous refractory container together with a small amount of metallic chromium out of contact with the foundation metal, placing the porous container within a non-porous container and packing between the containers an inert medium, such as aluminium oxide, together with about 2% by weight of ammonium chloride as a carrier and heating to about 1000° C. until the desired coating results.

Dated this 20th day of May, 1931.

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